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Lift and Circulation Formulas

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List of 16 Lift and Circulation Formulas

Lift and Circulation

1) Angle of Attack for Circulation developed on Airfoil

$$\text{fx } \alpha = a \sin\left(\frac{\Gamma}{\pi \cdot U \cdot C}\right)$$

[Open Calculator !\[\]\(a870788d6ed9b8fd294b7654a8c8526b_img.jpg\)](#)

$$\text{ex } 6.506912^\circ = a \sin\left(\frac{62\text{m}^2/\text{s}}{\pi \cdot 81\text{m}/\text{s} \cdot 2.15\text{m}}\right)$$

2) Angle of Attack for Lift Coefficient on Airfoil

$$\text{fx } \alpha = a \sin\left(\frac{C_{L \text{ airfoil}}}{2 \cdot \pi}\right)$$

[Open Calculator !\[\]\(c50c8b7b2cc2cf9ff925edec0ee94c0d_img.jpg\)](#)

$$\text{ex } 6.506638^\circ = a \sin\left(\frac{0.712}{2 \cdot \pi}\right)$$

3) Chord Length for Circulation developed on Airfoil

$$\text{fx } C = \frac{\Gamma}{\pi \cdot U \cdot \sin(\alpha)}$$

[Open Calculator !\[\]\(f60b7a900783ac3fd531bfd9c111be6d_img.jpg\)](#)

$$\text{ex } 2.152276\text{m} = \frac{62\text{m}^2/\text{s}}{\pi \cdot 81\text{m}/\text{s} \cdot \sin(6.5^\circ)}$$



4) Circulation developed on Airfoil

$$\text{fx } \Gamma = \pi \cdot U \cdot C \cdot \sin(\alpha)$$

[Open Calculator !\[\]\(cbe80b694ebd74fcfe136a095b608235_img.jpg\)](#)

$$\text{ex } 61.93442\text{m}^2/\text{s} = \pi \cdot 81\text{m/s} \cdot 2.15\text{m} \cdot \sin(6.5^\circ)$$

5) Circulation for Single Stagnation Point

$$\text{fx } \Gamma_c = 4 \cdot \pi \cdot V_\infty \cdot R$$

[Open Calculator !\[\]\(3e2231b1ad3ca8da8658228c00dd08e0_img.jpg\)](#)

$$\text{ex } 243.1593\text{m}^2/\text{s} = 4 \cdot \pi \cdot 21.5\text{m/s} \cdot 0.9\text{m}$$

6) Circulation in Location of Stagnation Points

$$\text{fx } \Gamma_c = -(\sin(\theta)) \cdot 4 \cdot \pi \cdot V_\infty \cdot R$$

[Open Calculator !\[\]\(0d5ec72f61334709c3fc9450209b754f_img.jpg\)](#)

$$\text{ex } 243.1593\text{m}^2/\text{s} = -(\sin(270^\circ)) \cdot 4 \cdot \pi \cdot 21.5\text{m/s} \cdot 0.9\text{m}$$

7) Coefficient of Lift for Airfoil

$$\text{fx } C_{L \text{ airfoil}} = 2 \cdot \pi \cdot \sin(\alpha)$$

[Open Calculator !\[\]\(b64b40baaee5acddc1eab8538ba84754_img.jpg\)](#)

$$\text{ex } 0.711277 = 2 \cdot \pi \cdot \sin(6.5^\circ)$$

8) Lift coefficient for lift force in body moving on fluid

$$\text{fx } C_L = \frac{F_L'}{A_p \cdot 0.5 \cdot \rho \cdot (v^2)}$$

[Open Calculator !\[\]\(aff7c69c44a5e015f18c35867ef3f5c3_img.jpg\)](#)

$$\text{ex } 0.944451 = \frac{1100\text{N}}{1.88\text{m}^2 \cdot 0.5 \cdot 1.21\text{kg/m}^3 \cdot ((32\text{m/s})^2)}$$



9) Lift Coefficient for Rotating Cylinder with Circulation

$$\text{fx } C' = \frac{\Gamma_c}{R \cdot V_\infty}$$

[Open Calculator !\[\]\(e78f798d4ea5c530c9db49e7d26e6b95_img.jpg\)](#)

$$\text{ex } 12.55814 = \frac{243\text{m}^2/\text{s}}{0.9\text{m} \cdot 21.5\text{m}/\text{s}}$$

10) Lift Coefficient for Rotating Cylinder with Tangential Speed

$$\text{fx } C' = \frac{2 \cdot \pi \cdot v_t}{V_\infty}$$

[Open Calculator !\[\]\(05be7c7a8995decd503647c99211f7c2_img.jpg\)](#)

$$\text{ex } 12.56637 = \frac{2 \cdot \pi \cdot 43\text{m}/\text{s}}{21.5\text{m}/\text{s}}$$

11) Lift Force for Body moving in Fluid

$$\text{fx } (F_L') = \frac{C_L \cdot A_p \cdot M_w \cdot (v^2)}{V_w \cdot 2}$$

[Open Calculator !\[\]\(fe3aebe81acea8d45108cd2768939da7_img.jpg\)](#)

$$\text{ex } 1098.693\text{N} = \frac{0.94 \cdot 1.88\text{m}^2 \cdot 3.4\text{kg} \cdot ((32\text{m}/\text{s})^2)}{2.8\text{m}^3 \cdot 2}$$

12) Lift Force for body moving in Fluid of Certain Density

$$\text{fx } F_L = C_L \cdot A_p \cdot \rho \cdot \frac{v^2}{2}$$

[Open Calculator !\[\]\(899d8b7697d64725bf017d3296cfcf1b_img.jpg\)](#)

$$\text{ex } 1094.816\text{N} = 0.94 \cdot 1.88\text{m}^2 \cdot 1.21\text{kg}/\text{m}^3 \cdot \frac{(32\text{m}/\text{s})^2}{2}$$



13) Lift Force on Cylinder for Circulation

$$fx \quad F_L = \rho \cdot l \cdot \Gamma_c \cdot V_\infty$$

[Open Calculator !\[\]\(e2376d476d06eb31946dc01a69a4403a_img.jpg\)](#)

$$ex \quad 53733.98N = 1.21kg/m^3 \cdot 8.5m \cdot 243m^2/s \cdot 21.5m/s$$

14) Radius of Cylinder for Lift Coefficient in Rotating Cylinder with Circulation

$$fx \quad R = \frac{\Gamma_c}{C' \cdot V_\infty}$$

[Open Calculator !\[\]\(0b5e7e25e8775f7e7e80906ada4f0021_img.jpg\)](#)

$$ex \quad 0.900584m = \frac{243m^2/s}{12.55 \cdot 21.5m/s}$$

15) Tangential Velocity of Cylinder with Lift Coefficient

$$fx \quad v_t = \frac{C' \cdot V_\infty}{2 \cdot \pi}$$

[Open Calculator !\[\]\(bd3b31712ad9bab5a241210fa6925cdd_img.jpg\)](#)

$$ex \quad 42.94398m/s = \frac{12.55 \cdot 21.5m/s}{2 \cdot \pi}$$

16) Velocity of Airfoil for Circulation developed on Airfoil

$$fx \quad U = \frac{\Gamma}{\pi \cdot C \cdot \sin(\alpha)}$$

[Open Calculator !\[\]\(7bc43b319a082987e20f7bf78f4bab80_img.jpg\)](#)

$$ex \quad 81.08576m/s = \frac{62m^2/s}{\pi \cdot 2.15m \cdot \sin(6.5^\circ)}$$











Variables Used


- A_p Projected Area of Body (Square Meter)
- C Chord Length of Airfoil (Meter)
- $C_{L \text{ airfoil}}$ Lift Coefficient for Airfoil
- C_L Lift Coefficient for Body in Fluid
- C' Lift Coefficient for Rotating Cylinder
- F_L Lift Force on Rotating Cylinder (Newton)
- F_L' Lift Force on Body in Fluid (Newton)
- l Length of Cylinder in Fluid Flow (Meter)
- M_w Mass of Flowing Fluid (Kilogram)
- R Radius of Rotating Cylinder (Meter)
- U Velocity of Airfoil (Meter per Second)
- v Velocity of Body or Fluid (Meter per Second)
- V_∞ Freestream Velocity of Fluid (Meter per Second)
- v_t Tangential Velocity of Cylinder in Fluid (Meter per Second)
- V_w Volume of Flowing Fluid (Cubic Meter)
- α Angle of Attack on Airfoil (Degree)
- Γ Circulation on Airfoil (Square Meter per Second)
- Γ_c Circulation Around Cylinder (Square Meter per Second)
- θ Angle at Stagnation Point (Degree)
- ρ Density of Fluid Circulating (Kilogram per Cubic Meter)



Constants, Functions, Measurements used

- **Constant:** **pi**, 3.14159265358979323846264338327950288
Archimedes' constant
- **Function:** **asin**, asin(Number)
The inverse sine function, is a trigonometric function that takes a ratio of two sides of a right triangle and outputs the angle opposite the side with the given ratio.
- **Function:** **sin**, sin(Angle)
Sine is a trigonometric function that describes the ratio of the length of the opposite side of a right triangle to the length of the hypotenuse.
- **Measurement:** **Length** in Meter (m)
Length Unit Conversion 
- **Measurement:** **Weight** in Kilogram (kg)
Weight Unit Conversion 
- **Measurement:** **Volume** in Cubic Meter (m³)
Volume Unit Conversion 
- **Measurement:** **Area** in Square Meter (m²)
Area Unit Conversion 
- **Measurement:** **Speed** in Meter per Second (m/s)
Speed Unit Conversion 
- **Measurement:** **Force** in Newton (N)
Force Unit Conversion 
- **Measurement:** **Angle** in Degree (°)
Angle Unit Conversion 
- **Measurement:** **Density** in Kilogram per Cubic Meter (kg/m³)
Density Unit Conversion 



- **Measurement: Momentum Diffusivity** in Square Meter per Second (m^2/s)
Momentum Diffusivity Unit Conversion 



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